Thomas Skeete. —
Donum Auctor
July. 17. 178

OBSERVATIONS

AND

EXPERIMENTS

ON THE

POWER OF THE MEPHYTIC ACID IN DISSOLVING STONES OF THE BLADDER.

IN A LETTER TO

DR. PERCIVAL.

BY

WILLIAM SAUNDERS, M.D.

And One of the Phyſicians to GUY'S HOSPITAL.

LONDON:

Printed in the Year MDCCLXXVII.

1609/5459

BRITISH MUSEUM
30 NOV 73

THE following letter was ſome time ago ſent to Dr. Percival, and by him firſt publiſhed in the third volume of his Philoſophical, Medical, and Experimental Eſſays.

THIS ſubject has been ſince proſecuted by Dr. Percival and Dr. Falconer of Bath, who have confirmed by their experiments that my opinion of the ſolvent power of the mephytic acid on human calculi was well founded.

I AM fully convinced from a variety of trials, that water impregnated with this acid is carried in circulation unchanged to the human bladder, and that this remedy has done great ſervice in calculous complaints.

THE only ſolvent now in uſe is the lixivium, which is recommended to the public under various forms as a ſpecific remedy in calculous diſorders; the irritation and pain which it generally produces is beſt removed by joining to it an opiate.

THE miſchief which ariſes from perſevering in the uſe of this alkaline remedy, and the bad effects on the body from the animal and putreſcent regimen neceſſary for the preſervation of its powers, are fully pointed out in the following letter, as well as the abſurdity in the belief of one Univerſal Solvent of Human Calculi, which in their component and elementary parts ſo eſſentially differ.

DEAR SIR,

I HAVE at laſt found leiſure to comply with your requeſt, that I ſhould tranſmit to you an account of ſome important diſcoveries and improvements which I have made in applying the uſe of fixed air, or more properly the mephytic acid; to the practice of medicine, and more eſpecially for the purpoſe of diſſolving the human calculus. The public are already much indebted to you for that ſpirit of inquiry which you have ſo ſucceſsfully directed in recommending this uſeful medicine, in pulmonic diſorders, gangrenous ſore throats, and malignant fevers, and it affords me no ſmall pleaſure, that my experiments have not only met with your approbation, but have been confirmed by your proſecuting the ſame ſubject with equal ſucceſs, ſo as to put it out of all doubt that we are now in poſſeſſion of a more efficacious and pleaſant ſolvent for the human calculus, than any hitherto in uſe, and that it reaches the urinary paſſages in its full force, communicating its ſolvent power to the urine. I ſhall hope likewiſe to make it appear, that it poſſeſſes every advantage over the lixivial and other boaſted ſolvents now in uſe, it being ſalutary to the conſtitution and checking that tendency to putrefaction which is ſo prevalent in calculous habits, and which is ſo much increaſed by alkaline ſalts and the ſeptic regimen, generally recommended along with them.

I WAS firſt led to proſecute this ſubject from the following experiments of Dr. Hales, and which I have repeated with the ſame ſucceſs.

" THOUGH I have not herein ſucceeded ſo far, as to encourage any one to " attempt the diſſolving therewith gra" vel-ſtones in the bladder, yet I thought " it might not be improper to give an " account of the ſmall progreſs I had " made herein, ſince it might poſſibly " be a ſtep towards the happy and im" portant diſcovery, by exciting and en" gaging others in the ſame purſuit; who " among the infinite variety of menſtru" ums that may be compounded, may " haply hit upon ſome, which may more " eaſily diſſolve moſt gravel-ſtones at " leaſt, if not the larger and harder " *Calculi*. If we could make no farther " advance than this, it would be of con" ſiderable benefit to mankind, by tak" ing away, when it firſt falls into the

" bladder, the *Nucleus*, on which larger " and harder ſtones are in time formed. " And this would be effected, if with a " few injections of a ſafe and proper " menſtruum, we could only diſſolve a " ſmall part of a large gravel-ſtone, late- " ly fallen from the kidnies, ſo as to " make it fit to paſs off through the " *Urethra*; which it would alſo do with " more eaſe to the patient, by having " thereby its ſurface and ſharper points " ſoftened and made mucilaginous, and " ſtimulating. This is what the fer- " menting mixture I am going to give " an account of, will do on ſome of the " ſofter ſtones, but not without too many " repeated injections, to make it practi- " cable with ſafety to the patient.

" THAT I might with the greater " accuracy and readineſs vary and adjuſt, " as occaſion required, the ſeveral pro- " portions of the fermenting mixtures, " I divided the capacity of ſeveral glaſs

“ veſſels, out of which I poured the li-
“ quors, into cubic inches, making
“ marks with a file on the outſide of the
“ glaſſes, at each diviſion. I divided
“ alſo the capacity of a large tube into
“ quarter cubic inches; it was half inch
“ diameter, and ſealed at one end. I
“ made alſo ſeveral diviſions on a ſhort
“ tube, which was quarter of an inch
“ diameter, the capacity of each diviſion
“ containing ten drops of oil of ſulphur;
“ ſo that by dipping one end of this
“ tube in liquor to any of theſe marks,
“ and then ſtopping the other end with
“ my finger, I could readily take up ten,
“ twenty, thirty, forty, or fifty drops, or
“ any intermediate number.

“ I WILL now give a ſhort account of
“ ſome of the principal experiments I
“ made; in doing of which I did not
“ confine myſelf to ſuch mild mixtures,
“ as might probably not be injurious to
“ the bladder, but choſe to begin with

" the ſtrongeſt fermenting mixtures, in
" hopes that if I ſhould find any of theſe
" would diſſolve the *Calculus*, by gradually weakening and lowering ſuch mixture, I might poſſibly bring it to ſuch
" a degree of mildneſs, as might make
" it not injurious to the bladder, and
" yet retain in ſome meaſure its diſſolving quality. Or if I ſhould not be ſo
" happy as to ſucceed ſo far, yet I thought
" it moſt probable, that I might find
" diſſolvents, among theſe ſtronger mixtures, which might at leaſt give ſome
" farther inſight into the nature of the
" *Calculus*.

EXPERIMENT II.

" 1. A CUBIC inch of oil of vitriol,
" and double its quantity of water, when
" mixt together, made ſo hot a ferment,
" that I could hardly bear to hold my
" hand at the bottom of the bolthead;
" yet

" yet it had no effect on a piece of the
" hardeſt kind of *Calculus.* And it was
" the ſame when the heat and ferment
" was renewed by throwing in ſome
" filings of iron.

" 2. The like proportions of oil of vi-
" triol and water, with ſeveral kinds of
" powdered vitriolic ſtones or *Pyrites,*
" made violent ferments, but had no effect
" on this very hard *Calculus.*

" 3. It was the ſame with oil of vi-
" triol, and other acid ſpirits, when pour-
" ed on ſeveral alkaline bodies, ſuch as
" powdered *Belemnites, Aſteria,* coral and
" oyſter-ſhell, *&c.*

" 4. But oil of vitriol mixed with
" unrectified ſpirit of C. C. though it
" would not diſſolve the above-mention-
" ed very hard piece of *Calculus,* yet
" with ten or twelve freſh mixtures, it
" rotted and diſſolved ſeveral pretty thick
" *Laminæ,* or cloves of other *Calculi;*

“ which though not of ſo compact a texture as the other, yet were ſo hard, “ that I could not make any impreſſion “ on them with my nail: but this was “ too pungent a mixture to give any “ hopes that the bladder can bear any degree of it.

“ 5. SPIRIT of rye-bread being found “ by chymiſts a diſſolvent ſo powerful “ as to diſſolve ſeveral kinds of ſtones “ and hard ſubſtances, and yet withal ſo “ mild, that it may with great ſafety be “ held in the hollow of the hand; I prepared a good quantity of it, both unrectified and rectified, and made it one “ in a great variety of briſkly fermenting “ mixtures, in hopes that by thus putting “ its parts in a briſk motion, it might “ have made ſome impreſſion on the *Calculus*, but it had none.

“ 6. I MADE a preparation of tartar “ of vitriol, by mixing one part of oil

" of vitriol, with twice its quantity of
" hot water, in which were pieces of
" *Calculus* and tartar; the *Calculus* emit-
" ted bubbles, but not the tartar: then
" I poured in gradually *Ol. Tart.* when
" both *Calculus* and tartar emitted for
" ſome minutes a great quantity of bub-
" bles. The tartar was alſo at once diſ-
" ſolved, and the *Calculus* was very rot-
" ten and brittle, but it was not of the
" very hard kind; *Sal Tartar*, which is
" a fixt alkali, being leſs corroſive than
" ſpirit of harts-horn, which is a volatile
" alkali.

EXPERIMENT III.

" 1. I MADE a ſolution of it in
" water, in the proportion of an ounce
" of *Sal Tartar* to four of water; and
" made many briſk fermentations, with
" ſeveral portions of this alkaline mix-
" ture, by pouring in of the ſtrongeſt

" acid ſpirits, as ſpirit of nitre, ſpirit of
" ſalt, ſpirit and oil of vitriol, and oil
" of ſulphur. I found oil of vitriol and
" oil of ſulphur moſt effectual to my
" purpoſe; and of theſe two, I choſe
" rather to make uſe of oil of ſulphur
" than oil of vitriol, as being the purer
" acid of the two, and leſs noxious to
" animal bodies than oil of vitriol.

" 2. I FOUND, after the mixture of a
" great variety of proportions of theſe
" liquors, that the following were the
" propereſt for my purpoſe, *viz.* one
" cubic inch of water, one third of a
" cubic inch of ſolution of *Sal Tartar*,
" and twenty-five, or ſometimes thirty
" drops of oil of ſulphur; alſo ſix cubic
" inches of water, $\frac{3}{4}$ cub. of the ſolu-
" tion of *Sal Tartar*, and fifty drops of
" oil of ſulphur.

" 3. THESE proportions fermented
" briſkly, and made air bubbles ariſe

" very faſt from the *Calculi* for eight or " ten minutes, as would alſo ſeveral " other proportions, though I did not find " any ſo effectual as theſe, which after ſe- " veral freſh affuſions of them, would diſ- " ſolve ſome *Calculi* which were hard to " the touch. They would alſo diſſolve " ſeveral gravel-ſtones, though not all; " nor had they any effect on many of the " hardeſt *Calculi*.

" 4. If air do not ariſe briſkly from " the *Calculus*, upon pouring on any of " theſe mixtures, the rule to adjuſt the " proportions accurately, is to drop in a " few drops of oil of ſulphur; if this " addition make more air ariſe from the " *Calculus*, it is a ſign ſome of it was " wanting; but if more air does not " ariſe, then it is a ſign that more ſolu- " tion of *Sal Tartar* is wanting.

" 5. It fermented beſt, when half " the water was poured on the ſolution

" of *Sal Tartar*, and the ſpirit of ſulphur " was dropped into the other half, and " then both mixtures poured together. " Warm water was better than cold, " though it fermented longer cold.

" 6. WHEN there was a double quan-" tity of oil of ſulphur, I have not found " it more powerful in diſſolving; and " when the ſolution of *Sal Tartar* was " much ſtronger, the ferment was leſs.

" 7. THE liquor has no effect on the " *Calculus* after the ferment is over, as I " have found by laying ſeveral *Calculi* to " ſoak in it for a whole year. So that the " effect it has on the *Calculus* while it is " fermenting, ſeems not to depend on " the fitneſs of the particles of the men-" ſtruum to enter the pores of the *Cal-*" *culus*, but rather on certain harmonic " proportions between the vibrations of " the fermented liquor, and the tone or " degree of tenſeneſs of the parts of the " *Calculus*:

" *Calculus* : juſt as when two ſtrings " are equally tenſe, the ſtriking of one " will make the other ſound; or, as I " have often obſerved, the different pipes " of an organ will make different boards " vibrate, according to the uniformity " there is between the tenſeneſs of the " fibres of the ſeveral boards, and the " tone of the different pipes.

" 8. AND in like manner we may " not unreaſonably ſuppoſe, that when " there is the like uniformity between " the vibrations of the fermenting liquor, " and thoſe of the parts of the *Calculus*; " that the *Itus* and *Reditus* of theſe vibrations increaſing in this caſe each " other's force, ſome parts of the *Calculus* " are thereby thrown off into elaſtic air. " In confirmation of this conjecture, I " have obſerved air to ariſe briſkly from " a *Calculus* with twenty or ten drops of " oil of ſulphur; and yet with fifteen " drops little or no air aroſe, notwith-

" ſtanding the proportion of the other " ingredients of the fermenting mixtures " was the ſame in all three caſes."

It ſufficiently appears, from attending to theſe experiments, that the *Calculus* was diſſolved during the efferveſcence from the application of the fixed air ; for the ſolvent power ceaſed after the efferveſcence was over, and the neutral ſalt formed by the combination of the acid and alkali had no menſtrual power. I was confirmed in this opinion by the two following experiments, which ſeem to me perfectly deciſive upon that ſubject.

EXPERIMENT I.

TEN grains of a human *Calculus* were put into two ounces of diſtilled water, and after ſtanding for ſome hours, there was found no diminution of its weight, and the water ſhowed no precipitation upon the addition of a ſolution of ſilver in the nitrous acid, or of a very cauſtic alkali, prepared by Mr. Lane.

EXPERIMENT II.

TEN grains of the ſame *Calculus* was added to two ounces of diſtilled water, ſaturated with fixed air; it loſt three grains of its weight, and there was a precipitation upon the addition of the cauſtic alkali.

THIS laſt experiment has been repeated upon different *Calculi*, and they have been always found diſſolved in a greater or ſmaller proportion, admitting of that variety which might be expected in the ſolubility.

THESE two experiments are ſufficient to prove the ſolubility of the human *Calculus* in the mephytic acid, and, together with ſuch as you have made, ought to rouſe and excite the induſtry of medical people to a ſubject that promiſes ſuch ſingular advantages to mankind.

Dr. Hales, whoſe candour and judgment in conducting experimental enquiries cannot be too much admired, was entirely ignorant of the chemical properties of fixed air, and its effects, in combination or mixture with other bodies. I was encouraged in favouring the opinion, of its poſſeſſing a very univerſal ſolvent power, from the experiments of Mr. Cavendiſh and Mr. Lane, and from its appearing, when pure and ſeparate, in a permanent ſtate of elaſtic vapour, and its readineſs to return to that form from its ſtate of mixture, confirmed me more in this opinion; it being a general principle in chemiſtry, that the power of ſolution and mutual combination is greatly aſſiſted by the bodies employed being made to aſſume the ſtate of vapour. The very ingenious experiments of Mr. Bewly, as related in Dr. Prieſtley's ſecond volume on air, have thrown much light upon the chemical hiſtory of this body, and have put it beyond all doubt, that it is an acid of a particular kind, poſſeſſing a weaker attraction to alkalies, calcareous earths, magneſia, and other bodies, than any other acid; and that, therefore, in common with other acids, it loſes its ſolvent power in mixture or combination with other bodies. It was neceſſary to make this obſervation, in order to explain, why cauſtic alkalies and quick-lime loſe their active powers in combination with this acid; and that, therefore, mild alkalies and calcareous earths ought rather to be conſidered as, in ſome degree, in a ſtate of neutrality with this acid, whoſe power of attraction is ſo weak, and whoſe tendency to reſume its proper elaſtic form is ſo great, that it does not totally deſtroy the diſtinct and original properties of alkalies, or earths, with which it is united. I was much pleaſed with my ſucceſs on this ſubject, becauſe I had diſcovered, from various chemical trials, on the human calculus, and the urine of perſons labouring under that diſeaſe, that there was a diverſity in the nature and properties of their component elementary parts, and that the ſtrongeſt lixivium was inſufficient to diſſolve ſome calculi, which readily yielded to the application of fixed air. Of this fact I was particularly informed by my friend Mr. Lane, who has directed the public to the beſt method of preparing the lixivial ſolvent, and who has likewiſe engaged his attention to many uſeful and ingenious inquiries upon this ſubject.

It appears, from your experiments, that you found fixed air a very univerſal menſtruum for the human calculus; from which I am diſpoſed to think, that you have not extended your experiments to that variety which may afterwards occur. I am perſuaded, that in all human calculi there is a very large proportion of animal mucus, and more particularly in thoſe of a laminated ſtructure; while ſuch as put on a more ſhining chryſtalline form contain a larger proportion of ſaline and earthy matter.

It is impoſſible to determine abſolutely in what caſes one ſolvent ſhould be preferred to another, until the urine and its contents have been properly examined; and as it is ſufficiently proved by your own obſervations, that fixed air is conveyed by the powers of circulation unchanged to the bladder, impregnates the urine, and communicates to it its ſolvent power, we may reaſonably conclude, that when the urine of a particular perſon impregnated with fixed air, does not depoſit its terreſtrial parts, or, when it has depoſited them, the fixed air can be made to rediſſolve them, the mephytic ſolvent is beſt adapted to ſuch a conſtitution. If on the other hand, ſuch be the nature of the *Calculus* concretions, that they conſiſt chiefly of earthy matter laminated and cemented by animal mucilage, the lixivial ſolvent will exert a more powerful operation in ſoftening and deſtroying the coheſion of the *Calculus* in ſuch a manner as ſometimes to promote the ſeparation of its parts, and thereby facilitate its evacuation.

I AM confirmed in this opinion from having found by experiment, that the mucus which is diſcharged ſo plentifully by calculous patients, is readily ſoluble in the cauſtic lixivium, and that in attempting to diſſolve the human *Calculus* in the ſame lixivium, I generally perceived that it was rendered ſofter, and its texture diſcharged without any diminution of its earthy parts. I think it highly probable that advantages might ariſe from alternating the uſe of various ſolvents, and that after ſufficient trials have been made by the lixivial ſolvents, in many caſes the mephytic acid might be employed with additional advantages, the former diminiſhing the coheſion, and thereby facilitating the menſtrual power of the latter.

THIS method of preſcribing will obviate the objections which might ariſe from their being taken at the ſame time, becauſe they enter into that union with one another, as to diminiſh, if not perfectly to deſtroy their powers of ſolution. If a more powerful and active ſolvent than any hitherto known ſhall be diſcovered, it is highly probable that ſuch a diſcovery can only be made by a rational and chymical inquiry into the powers of different bodies of combining with the contents of the urine, and preſerving them in a fluid ſtate out of the body. It is well known that all the empirical remedies now in uſe, and recommended for diſſolving the human *Calculus*, are alkalies rendered more or leſs cauſtic by a combination with quicklime, and that in order to diſguiſe them, they are variouſly impregnated with bitter and other vegetable ſubſtances, and variouſly tinctured and coloured by different bodies, which can communicate to them no additional powers. To ſome an opiate is added, to take off that irritation which lixivial medicines produce in the urinary paſſages. The lixivial remedies employed for diſſolving the human *Calculus* are extremely deſtructive to ſome conſtitutions. There are inſtances of their having produced the moſt putrid diſeaſes, and increaſing a diſpoſition to ſcorbutic complaints.

THEY ſometimes bring on the moſt dangerous hæmorrhages, and the regimen employed, being chiefly animal diet, the putreſcent ſtate of the fluids is thereby greatly increaſed. I have likewiſe frequently obſerved ſo much irritation and pain, as to produce conſiderable inflammation in the bladder by the ſame means. If therefore future trials with the mephytic acid ſhall meet with the ſame ſucceſs experienced both by you and myſelf, it ought to be very generally preferred, becauſe the regimen beſt adapted to aſſiſt its operation is of the vegetable kind, and the free uſe of wine and fruits, the moſt powerful antiſeptics may be at the ſame time admitted in the form of diet; beſides it appears from Dr. Macbride's experiments, that the mephytic acid itſelf is the moſt powerful remedy in putrid and ſcorbutic diſorders, and may therefore be employed with the greateſt advantage in reſtoring a patient to perfect health, who may have ſuffered by perſevering in the uſe of the lixivium,

It now remains, that I ſhould ſay ſomewhat on the beſt method of preſcribing this uſeful remedy. In the firſt place, the patient ſhould be directed to prefer the uſe of ſuch water as contains it in the largeſt quantity, ſuch as Briſtol water, Seltzer water, Rathbone place water; and as it cannot be difficult to find water of this kind in moſt places, it ſhould be made one chief article of their diet. All hard water which becomes ſofter by being expoſed to the air or even by boiling, and depoſits a calcareous earth is of this kind, and the acidulæ of all countries have been conſidered as the moſt powerful lithontriptics.

At Chiſelhurſt, in Kent, on the eſtate of Lord Camden, there is a large ſpring of water which contains a very large proportion of fixed air; it is very hard when immediately taken from the ſpring, it however becomes ſoft by being long expoſed to the air, ſo as to diſſolve ſoap for the purpoſe of waſhing, and is employed and preferred for all culinary purpoſes:

its power of diſſolving marble and other ſtony matters is ſo great, that it cannot be confined in veſſels of theſe materials. It has been found, on repeated trials, that it acted upon the human *Calculus*; I ſhould therefore recommend the uſe of this or any ſimilar water in preference to any other. Of theſe material facts I was particularly informed by his Lordſhip. The ſkilful Phyſician may ſuggeſt a great variety of forms in which this ſalutary acid may be introduced. The moſt eligible manner of preſcribing it is by impregnating water with it in the manner recommended by Dr. Nooth, with his apparatus improved by Mr. Parker of Fleet Street. Saline draughts may be taken in their ſtate of efferveſcence, and it may be ſtill more agreeably preſcribed in the form of briſk vinous liquors, ſuch as Champagne, Perry, and the like.

I WISH it however to be underſtood, that the united obſervations of many practitioners on its internal uſe, are ſtill neceſſary to eſtabliſh it a very univerſal ſolvent of *Calculi* in the human bladder, and I give my conſent to the publication of this letter, more with a view of exciting a general inquiry into the powers of a probable remedy, than of confidently boaſting of the ſuperior efficacy of this acid, as eſtabliſhed by pathological obſervations; at the ſame time ſome caſes have occurred, which might lead to the moſt favourable opinion of its efficacy, but I rather chooſe to poſtpone the publication of theſe till its virtues ſhall be better aſcertained by farther trials, fully ſenſible of the fallacy and difficulty attending obſervations made, and concluſions drawn from a few caſes.

We ſhall be uſefully employed if by a rational inquiry of this kind, we can extricate the preſent practice, in ſuch caſes, from the hands of empirics, and prevent a deluded public from blindly confiding in the boaſted remedies or *noſtrums* on this ſubject, all of which, ſo far as I have examined by analyſis, are the lixivium in diſguiſe; a medicine, in my opinion, very unfriendly to the conſtitution, by deſtroying acidity, and, probably proving ſeptic to the body by neutralizing fixed air, and entering into mixture with it.

I am,
DEAR SIR,
With much Eſteem and Affection,
Your moſt obliged,
and humble Servant,

Jeffries Square, St.
Mary Axe, London,
Feb. 8, 7776.

WILLIAM SAUNDERS.

POSTSCRIPT.

(*a*) DR. HULME has lately favoured the public with an account of the ſucceſs of the Mephytic Acid in a man of ſeventy-two years, who after having employed the Lixivium and other medicines in general uſe

---

(*a*) Oratio de re Medica, &c. 4to. 1777.

uſe to no purpoſe, had recourſe to this remedy; he was ſoon relieved from the moſt excruciating pain, and paſſed with great eaſe large quantities of ſtones, which evidently appeared to have been diminiſhed by ſolution. He is at preſent without any complaint.

An ingenious friend of mine has lately experienced the efficacy of water impregnated with this acid, and has been relieved from much pain which attended the diſcharge of ſmall ſtones.

This remedy has the advantage over all others, that it may be preſcribed either in the form of medicine or diet, and is well adapted to the weakeſt ſtomachs.

A Chemical inveſtigation of the urine of a calculous patient will beſt determine the nature of the ſtone, and direct to the uſe of the moſt proper ſolvent.

THE END.

BRITISH MUSEUM
30 NOV 73